

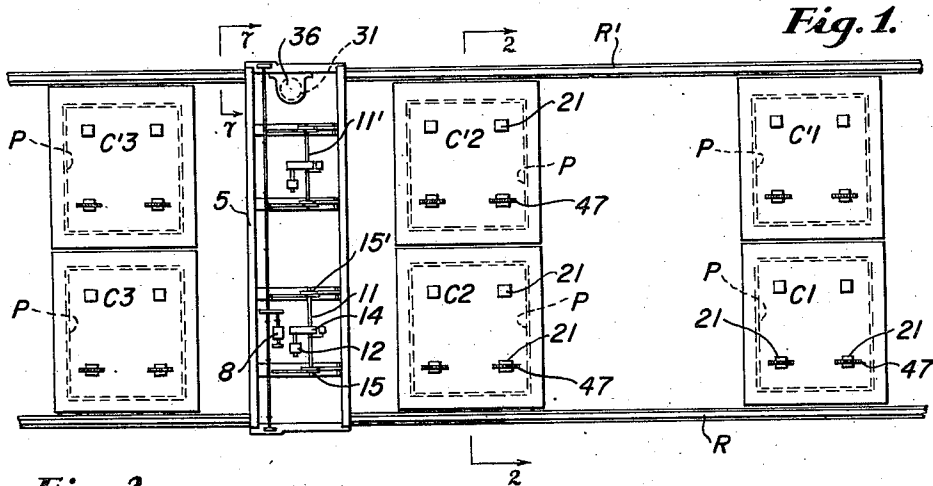
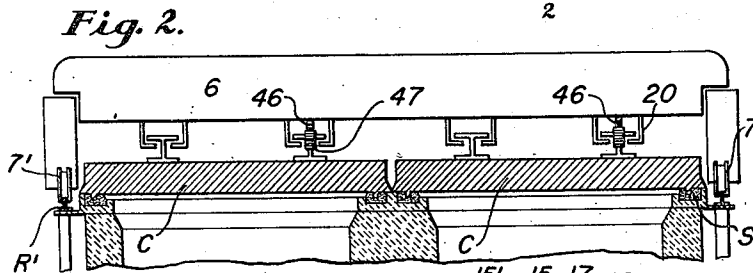
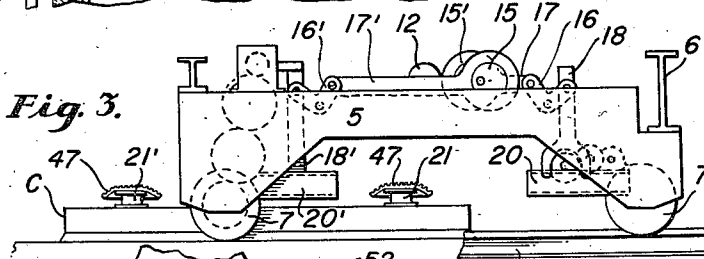
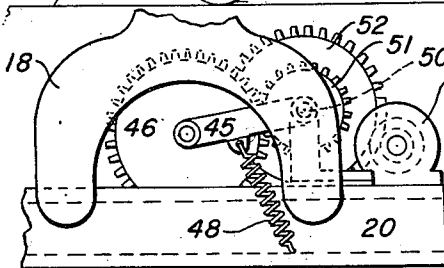
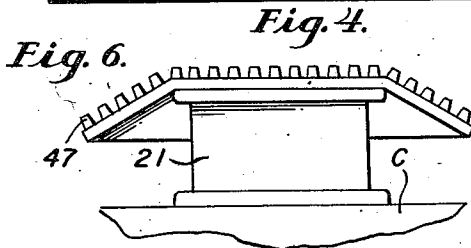
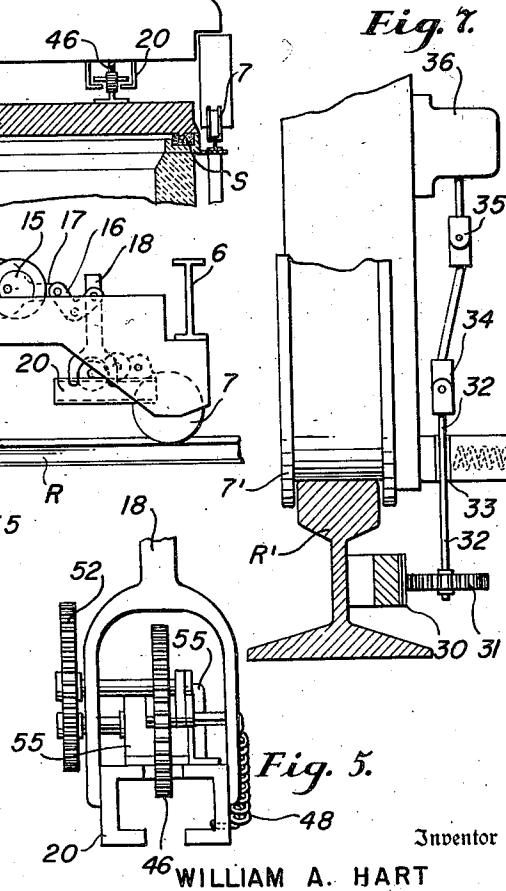
Jan. 14, 1958

W. A. HART
APPARATUS FOR AND METHOD OF OPERATING
SOAKING PIT FURNACE COVERS

2,819,802

Filed May 6, 1952

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 8.

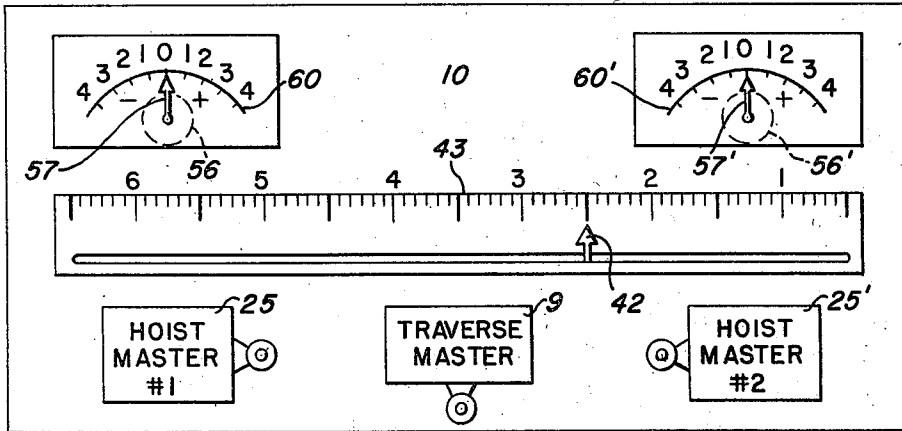
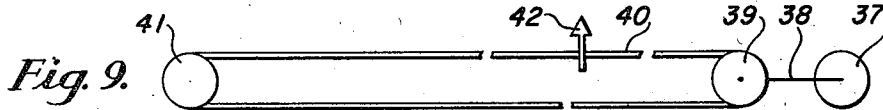
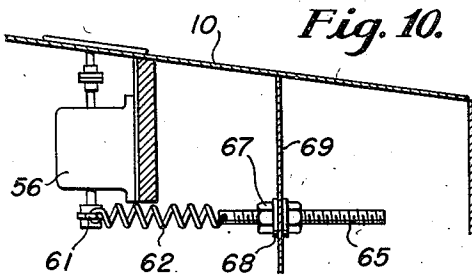


Fig. 10.

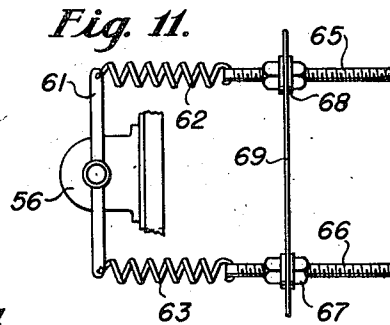


Fig. 11.

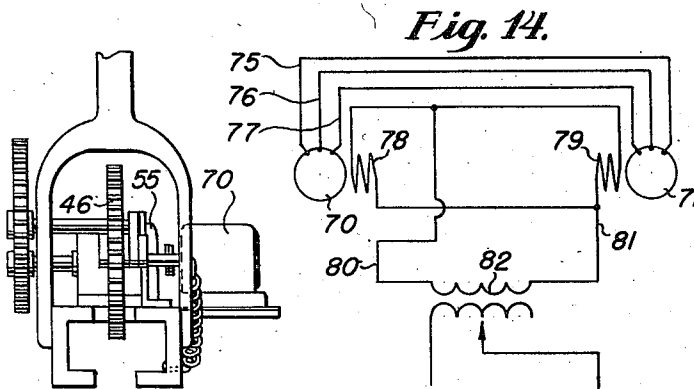


Fig. 12.

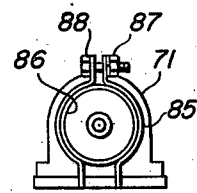


Fig. 13.

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1

2,819,802

APPARATUS FOR AND METHOD OF OPERATING SOAKING PIT FURNACE COVERS

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Application May 6, 1952, Serial No. 286,404

8 Claims. (Cl. 212—4)

This invention relates to soaking pits such as are used in steel mills for bringing ingots to uniform temperature after they have been poured in suitable molds and solidified sufficiently to enable the molds to be removed. The hot ingots are then deposited in the soaking pit and retained therein while heat dissipates from them and radiates to the walls and covers of the pit which therefore become so hot that when a cover is removed it is impossible to remain in the vicinity of the open pit without subjection to uncomfortably high temperatures.

The mechanical means hitherto provided for removing and replacing the soaking pit covers after introduction or withdrawal of an ingot require the presence of workmen in close proximity to the pit, the usual movable crane running on horizontal rails adjacent the latter being controlled electrically from a desk necessarily sufficiently near the pit to enable the operator to determine by direct observation when, for example, the crane is in position for handling a given cover and the relative relation between the latter and the pit. Even under these conditions it is extremely difficult to properly manipulate the covers when replacing them due to the impracticability of accurately judging whether the cover is in precisely the correct position for lowering onto its seat.

Normally the seat provided for the pit cover at the perimeter of the mouth of each pit includes a relatively narrow trough or channel which is kept filled with sand and into which a rib on the lower face of the cover adjacent its edge is intended to enter to provide an effective seal against undue loss of heat from the pit, and the importance of accurately positioning the cover before lowering it over an open pit arises from the tendency of the sand in these seals to build up at one side or the other of the channel provided for it if the cover is not exactly centered and thus gradually and cumulatively to prevent the cover after several removals and replacements from returning to its proper position in the seal.

It is therefore a principal object of the invention to provide means whereby the position of the soaking pit cover crane with respect to a soaking pit cover and of the latter relative to the soaking pit itself and particularly with respect to the sand seal surrounding the mouth of the pit may be determined from a point remote from the pit to thereby enable an operative at that point to remove and subsequently accurately replace the cover on a given pit by manipulation of conveniently placed controls located outside the zone of excessive heat and without the necessity of observing the cover and/or pit opening.

A further object is to provide mechanism indicating the relation of a pit cover to the soaking pit with which it is associated whereby even when the cover is displaced with respect to the pit before its removal therefrom it may be returned to the pit and accurately placed thereon in its proper position without the necessity of visually determining the relative position of the cover and pit from a point within the zone of intense heat or,

2

in fact, from any point whatsoever since the entire cycle of removing and replacing the cover may be performed solely by manipulation of certain controls at a remotely located control desk in accordance with indications afforded by appropriate instrumentalities comprised therein.

A still further object is to provide a method of handling soaking pit covers whereby they may be removed from and replaced on the respective soaking pits with which they are associated without subjecting the operative in control of the actual lifting and moving mechanism to excessive heat emanating from the pit or requiring that he observe directly the action of the mechanisms under his control in order to operate them properly.

Other objects, purposes and advantages of the invention will hereinafter more fully appear or will be understood from the following description of apparatus embodying it illustrated in the accompanying drawings in which,

Fig. 1 is a diagrammatic top plan view of a typical soaking pit installation in which six of a plurality of the individual pits constituting the installation are indicated.

Fig. 2 is a fragmentary enlarged vertical section thereof on the line 2—2 in Fig. 1.

Fig. 3 is a further enlarged fragmentary view in side elevation showing a single cover for one of the pits and certain of the mechanism for removing it from and replacing it on the pit.

Fig. 4 is a still further enlarged fragmentary detail showing a pit cover hook and associated apparatus.

Fig. 5 is a fragmentary end elevation of the mechanism illustrated in Fig. 4.

Fig. 6 is an enlarged fragmentary side elevation of one of the soaking pit cover knobs adapted for engagement by the cover lifting mechanism.

Fig. 7 is a fragmentary enlarged transverse section on line 7—7 in Fig. 1 illustrating certain of the mechanism employed in accordance with my system in the locating of the cover.

Fig. 8 is a diagrammatic representation of the instrument panel of a control desk from which control of the pit cover lifting means is exercised.

Fig. 9 is a diagrammatic representation of certain of the mechanism utilized in the control desk of which said panel forms a part.

Fig. 10 is a fragmentary vertical section through the control desk and instrument panel illustrating certain mechanism which may be disposed therein in accordance with one embodiment of the invention.

Fig. 11 is a bottom plan view of the said mechanism.

Fig. 12 is a fragmentary enlarged detail in elevation generally corresponding to Fig. 5 but showing certain elements of other mechanism which may be utilized instead for a generally like purpose.

Fig. 13 is an end elevation of an electrical-mechanical unit utilized therein; and

Fig. 14 is a wiring diagram illustrating the manner of interconnection into the system of the unit of Fig. 13.

Referring now more particularly to the drawings, Fig. 1 will be understood as being merely typical of soaking pit installations generally, there being indicated in dotted lines in the said Figure 6 pit furnace openings P disposed in spaced parallel rows and each provided with a cover $C_1, C_2 \dots C_n$ and $C'_1, C'_2 \dots$ and C'_n as representative of a greater or less number of furnaces which may be employed, their specific character and arrangement constituting no part of the invention. In accordance with usual practice a pair of rails R, R' extend in parallelism on opposite sides of the furnace rows for the full length of the soaking pit as a whole and support a transversely extending cover crane carriage 5 comprising a frame 6 movable along the rails on suitable wheels 7, 7' geared

to a driving motor 8 which is carried by frame 6 but connected by suitable conductors (not shown) to control mechanism including a traverse master switch 9 (Fig. 8) at a remote control-desk instrument panel 10 whereby the carriage may be moved along the rails in either direction and stopped at any appropriate point. The frame 6 also carries a pair of cover cranes 11, 11' respectively aligned with the furnace rows and substantially identical in character so that only one, e. g. crane 11, need here be described. It comprises a main energizing motor 12, and a speed reducer 14, operating eccentrics 15, 15' each of which is adapted to reciprocate a pair of cranks 16, 16' through pitmans 17, 17'. Arms 18, 18' depending from each pair of these cranks respectively support cover hooks 20, 20' at their lower ends, four such hooks being associated with each crane for engagement with corresponding knobs 21 on the subjacent soaking pit covers, each of which is consequently provided with four of these knobs suitably spaced on the cover to enable the crane to lift it therefrom when the knobs are engaged in the hooks and the latter raised.

The set of hooks on each crane is adapted for vertical reciprocation in unison by actuation of the crane motor, these being under control respectively of hoist master switches 25, 25' at the control desk 10, the crane mechanism being constructed as usual to move the hooks up or down in unison when the motor is energized and to hold them stationary when the motor is stopped.

It will be appreciated the mechanisms so far referred to are typical of those generally employed for handling soaking pit covers and hence require no more detailed description.

In accordance with the invention rail R' supporting frame 6 is provided with a rack 30 secured to its web and the frame carries a gear 31 meshing with this rack and supported by a shaft 32 rotatable in a spring pressed bearing 33 to drive through universal joints 34, 35 the transmitter 36 of a Selsyn system including suitable conductors (not shown) connecting it with a Selsyn receiver 37 at the control desk (Fig. 9). The receiver 37 through a shaft 38 drives a sheave 39 at one end of the control-desk instrument panel supporting an endless belt 40 running over another sheave 41 at the other end of the panel. This belt carries a pointer 42 which is thus reciprocal along a graduated scale 43 as the Selsyn receiver 37 turns in one direction or the other and the receiver is so connected and arranged as to move the pointer in exact correspondence to the movements of the crane along the rails whereby the operator merely through observation of the position of the pointer with relation to scale 43 may ascertain the position of the frame longitudinally of the rails and hence its relation to a selected pair of the soaking pits corresponding to those indicated on the scale by suitable number or other indicia, equal divisions between adjacent indicia corresponding to equal units of the distance between adjacent pairs of pit cover locations. Thus by reading the scale graduation designated by the pointer the operator may ascertain for example that at the reading illustrated in Fig. 8 the crane is stopped at a position intermediate the second and third pairs of pit covers and thus substantially in a position corresponding to that illustrated in Fig. 1.

On one of the hooks associated with each crane is mounted a pivoted arm 45 which supports a gear 46 adapted to mesh with a rack 47 on each of the subjacent knobs 21 of the several pit covers with which it is aligned, a spring 48 being arranged to bias the arm 45 to insure meshing of the gear with the racks during traverse of the crane. The hook also carries a shaft 50 supporting suitable gears 51, 52 of a gear-ratio-increasing train driving a Selsyn transmitter 55 interconnected through conductors (not shown) with a Selsyn receiver 56 in the control desk arranged to operate a corresponding indicat-

ing pointer 57 on the desk instrument panel. Two such pointers 57, 57' and respectively associated scales 60, 60' are shown, one for each crane, the scales being graduated in divisions corresponding to equivalent units of the distance along the racks 47 the gears 46 can be moved while in mesh with the racks. These indicators thus show exactly the relation between the crane and the subjacent cover as a function of the rotation of gear 46 by rack 47 on the cover knob with which the hook is at any time engaged, since the hook drives the gear as the crane carriage progresses along the knob and thereby through impulses transmitted by the Selsyn transmitter 55 to receiver 56 at the panel correspondingly adjusts the position of the indicator. Preferably each of indicators 57, 57' is so arranged that when the corresponding hook is precisely centered on the knob in proper position for the crane to raise the cover to which the knob is attached the indicator points to either +4 or -4 depending on the direction the crane has been moved along rails to bring the hook to this position, and points to 0 when the gear has been disengaged from the rack of one knob and while the crane is bringing it to an adjacent knob.

To insure return of pointers 57, 57' to 0 whenever gear 46 is out of engagement with any of the cover knob racks 47 I preferably provide appropriate instrumentalities one embodiment of which is illustrated in Figs. 10 and 11 and another in Figs. 12-14. More particularly as shown in the former figures I may key or otherwise secure to the shaft of each Selsyn receiver 56, housed within the desk, a walking beam 61 extending radially outward from the shaft in opposite directions having connected with the extremities of its arms a pair of springs 62, 63 respectively stretched between said extremities and adjustable fixed retaining bolts 65, 66 provided with nuts 67 and washers 68 embracing a partition 69 or other fixed support in the desk whereby the tension of the said springs may be varied. Desirably the bolts are adjusted so that when the torque of motor 56 is zero its shaft is held by the springs at a position corresponding to the 0 position of pointer 57 on scale 60; hence if the shaft is turned from that position one of the springs is placed under greater tension than the other and tends to return the shaft thereto unless it is positively restrained from so doing by engagement of gear 46 with one of the racks 47.

If preferred, however, other means may be employed for restoring the pointers 57 to 0 position, one embodiment of such means (Figs. 12, 13, 14) including a supplemental Selsyn motor 70 mechanically interconnected with the shaft of motor 55 (Fig. 12) which is connected by self-synchronous circuits illustrated in Fig. 14 to a like motor 71 mounted at a convenient position on the crane or elsewhere having its secondary windings connected with corresponding windings of motor 70 through leads 75, 76, 77 while the primary windings 78, 79 are connected in parallel through leads 80, 81 across the secondary of a manually adjustable voltage transformer 82 through which the Selsyn motor primary coils are energized. Motor 71 is provided with a brake 85 engaging a drum 86 on its shaft and adapted to be locked against the said drum to inhibit rotation of the motor shaft by a nut 87 and bolt 88 whereby motor 70 may be set to a desired position corresponding to 0 position of motor 55 and with the transformer energized to supply the amount of torque required to overcome the frictional load in the system motor 70 after gear 46 has been released from a rack on a pit cover always returns motor 55 to position corresponding to 0 indication of pointer 57 (or 57') with which said motor may be connected as previously described.

In now describing the operation of the mechanism I shall assume the control desk including the instrument panel 10 is situated at a point remote from the soaking pit to afford comfortable conditions for the operator and

5

also one from which he cannot minutely observe the action of the cover lifting cranes; that the various electrical circuits are energized, and that the apparatus is in general in the condition illustrated in the drawings. Now when it is desired to remove a selected cover, e. g. cover C_3 (Figs. 1-3) from the subjacent pit hole for insertion or removal of an ingot, traverse master switch 9 at the control panel is first operated to move crane carriage 5 to a position in substantial alignment with that cover, i. e. to the left in Fig. 1 through the position indicated in Fig. 3 to one in which hooks 20 are vertically aligned with knobs 21 on cover C_3 ; during this movement pointer 42 moves from the position indicated in Fig. 8 toward alignment with the number 3 on scale 43 indicating that the crane is approaching vertical alignment with the selected cover C_3 which corresponds to said number 3. When hook 20 of the crane engages knob rack 47 on cover C_3 and indicator 57 correspondingly moves from zero position toward the right or left depending on the electrical connections, its movement of course indicates to the operator that the hook is now engaging the knob. If the cover is exactly in its proper position on the pit hole, when indicator 42 reaches alignment with the number 3 on crane scale 43, indicator 57 on the hook scale points toward a numeral 4 (in the assumed case toward the left or negative side of the scale) and the operator thereupon actuates switch 9 to stop the crane. If however the cover is out of proper alignment with the pit hole indicator 57 may point to 4 before indicator 42 reaches the number 3 or may not point to it until the latter has been passed, either condition at the stopping of the crane showing that the cover was improperly positioned on the hole by an amount corresponding to the departure of indicator 42 from the number 3. In any case the operator always stops the crane when pointer 57 is at 4 since hooks 20 are then properly centered over the cover irrespective of whether the cover is exactly centered on the pit.

After stopping the crane motor the operator then manipulates hoist master switch 25 controlling the corresponding crane to lift cover C_3 from its pit and then through the instrumentality of the traverse master switch 9 moves the crane and cover it is carrying away from the pit hole, either to the left or right in Fig. 1, to permit access to the hole by the ingot lifting crane (not shown). Thereafter when the cover is to be replaced and with the hook indicator pointer 57 still pointing to the negative numeral 4 on scale 60, the traverse master switch is operated to bring the crane over the open pit and indicator pointer 42 exactly to alignment with the number 3 on scale 43 at which point traverse of the crane is stopped and the cover is lowered onto the pit hole where it must assume precisely the proper relation to its sand seal in the channel at the periphery of the hole regardless of its position relative thereto when it was lifted.

If through accident or otherwise the cover has shifted relatively to the hooks while suspended therefrom the hook indicating pointer 57 does not point to the number 4 on scale 60 but, for example, to 3 and the operator then compensates for the shifting by stopping the crane when crane pointer 42 is one unit away from the number 3 on crane scale 43 before lowering the cover to the pit thus insuring its replacement in proper position. Normally the cover does not shift its position relatively to the hooks while suspended from them but this ability to compensate for such shifting should it occur demonstrates the versatility of my system and method, which enables pit covers to be removed and replaced, not only at the position from which they have been taken but when that is not the proper one then exactly to the latter without mathematical calculation but with mathematical precision without direct observation of the cover or pit hole by the operator. Consequently each time a cover is lowered it is positioned exactly as it should be on the pit hole with its sealing rib properly entering sand seal S at the perimeter of the hole, after which the crane

6

is moved away to operate another cover. On its return to again operate the same cover whether or not displacement of the cover has occurred in the meantime, indicator 57 again shows when the crane is exactly aligned with the selected cover.

When traversing the crane from one point to another hooks 20 can of course be raised so as to clear the knobs on the inner covers intermediate the said points, but to avoid the necessity of lifting the hooks yet without causing excessive wear on gear 46 each longitudinally aligned set of knobs on one side of each series of covers is preferably provided with a rack 47 with the result that each time the gear passes over any one of said knobs it will be rotated and corresponding pointer 57 will therefore fluctuate. However, by observing crane pointer 42 the operator can readily determine if hooks 20 are approximately in proper position for lifting any given cover since that condition obtains only when that pointer is substantially aligned with the corresponding cover number on its scale.

It will be appreciated from what has been said that whenever gears 46 are disengaged from the cover knob racks each of pointers 57, 57' respectively controlled from its appropriate gear is promptly returned to 0 position through the operation of the mechanisms illustrated respectively in Figs. 10 and 11 and 12-14, whichever may be embodied in the apparatus, with the result that when the gears next engage one of the racks the apparatus as a whole is in condition to properly register the arrival of hooks 20 at a point appropriate for raising the subjacent pit cover, springs 62, 63 or the torque of the Selsyn motors 70, 71 being adequate to overcome the inherent frictional resistance in the system opposing return of the parts to 0 position.

As above stated, when my apparatus and method are employed it is immaterial whether or not the operative in control of the pit cover cranes is in a position from which he can see them since without direct observation he can exercise at least as accurate control as with it, and normally even better. The control desk may therefore be disposed at any suitable place affording comfortable working conditions and if desired adjacent the controls for the crane used for depositing the ingots in and removing them from the soaking pit.

While I have herein described with considerable particularity by way of example only apparatus embodying the invention and operable in accordance with the method thereof, it will be understood I do not desire or intend thereby to be limited or confined thereto in any way, as changes and modifications in the form, structure, arrangement and relationship of the parts of the apparatus as well as in the performance of said method will readily occur to those skilled in the art and may be made if desired without departing from the spirit and scope of the invention as defined in the appended claims.

Having thus described my invention, I claim and desire to protect by Letters Patent of the United States:

1. In combination with remotely controlled soaking pit cover handling apparatus including a cover crane movable horizontally above the pit and knobs on the pit covers engageable by the crane, means for indicating the position of the crane relatively to the pit and means for indicating its position relatively to a cover knob, said last mentioned means including a gear carried by the crane, a rack on the cover knob adapted to mesh with said gear during a portion of the possible movement of the crane, movable indicating means controlled from the gear but remote therefrom and means for moving the indicating means in correspondence to movements of the gear when in mesh with the rack.

2. Apparatus as defined in claim 1 in which the crane is movable along horizontal rails and includes a second rack paralleling one of the rails, a second gear adapted to mesh with the second rack and rotatably supported from the crane, and means interconnecting said second

gear with said first indicating means for moving the latter in correspondence to rotation of the second gear when in mesh with the second rack.

3. In apparatus for handling soaking pit covers provided with lifting knobs and including a horizontally traveling crane having vertically reciprocal hooks adapted to engage said knobs, that improvement which comprises driving means on one knob on each cover, means supported from one of the hooks adapted to be driven by the driving means when engaged therewith during movement of the crane, a crane position indicator remote from the crane and a Selsyn system interconnecting the driven means and indicator to actuate the latter in correspondence to movements of the driven means induced by the driving means.

4. In combination with remotely controlled soaking pit cover handling apparatus including a cover crane movable horizontally above the pit and knobs on the pit covers engageable by the crane, means for indicating the position of the crane relatively to the pit and means for indicating its position relatively to a cover knob including a gear carried by the crane, a rack on the cover knob adapted to mesh with said gear during a portion of the possible movement of the crane, movable indicating means controlled from the gear but remote therefrom and means for moving said indicating means in correspondence to movements of the gear when in mesh with the rack, and means operative to maintain said means for indicating the position of the crane relatively to a cover knob in a predetermined position whenever said gear is out of mesh with said rack.

5. In apparatus for handling soaking pit covers provided with lifting knobs and including a horizontally traveling crane having vertically reciprocal hooks adapted to engage said knobs, that improvement which comprises driving means on at least one knob on each cover, means adapted to be driven by the driving means when engaged therewith during movement of the crane, a position indicator remote from the crane, a Selsyn system interconnecting the driven means and indicator to actuate the latter in correspondence to movements of the driven means induced by the driving means, and means operative to return said indicator to a predetermined position on disengagement of the driven means from the driving means.

6. In apparatus for handling soaking pit covers provided with lifting knobs and including a horizontally traveling crane having vertically reciprocal hooks adapted

to engage said knobs to lift the covers, that improvement which comprises a rack on at least one knob on each cover, a gear supported from one of the hooks for rotation by a rack when traversed thereover by movement of the crane, a position indicator remote from the crane, a Selsyn system interconnecting the gear and indicator to actuate the latter in correspondence to rotation of the gear, and means operative to return the indicator to a predetermined position upon disengagement of the gear and rack following displacement of the indicator from said position as a result of rotation of the gear induced by its traverse of the rack.

7. A method of operating a soaking pit cover traveling crane having control means actuated at a station remote from the pit which comprises moving the crane along a horizontal path adjacent a cover until a predetermined relation between the crane and cover is established, actuating the crane to raise the cover from the pit, moving the crane along said path to expose the open pit and then returning the crane to a predetermined position relatively to the pit preparatory to replacing the cover.

8. The method of operating a soaking pit furnace cover crane from a control station remote from the soaking pit covers, which comprises the steps of bringing the crane into a predetermined cover lifting position with respect to a selected cover irrespective of the relative position of said cover and its pit, then raising the cover from said remote station, translating the crane and the raised cover to a clear position, thereafter returning the crane and the pit cover to a predetermined position with respect to the pit opening, said returning operation being controlled from the remote control station and then lowering the pit cover to accurately engage the seal at the furnace top.

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